PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B01F 5/06 A1

(11) International Publication Number: WO 92/14541

(43) International Publication Date: 3 September 1992 (03.09.92)

(21) International Application Number: PCT/GB92/00311

(22) International Filing Date: 20 February 1992 (20.02.92)

(30) Priority data:
9103524.6 20 February 1991 (20.02.91) GB

(71) Applicant *(for all designated States except US)*: DENA TECHNOLOGY [GB/GB]; Barnsley Business and Innovation Centre, Innovation Way, Barnsley, South Yorkshire S75 1JL (GB).

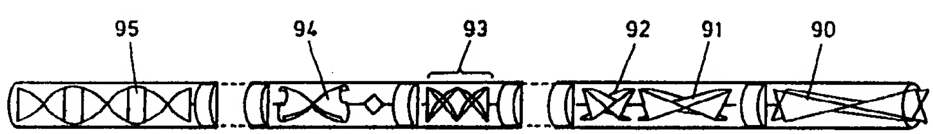
(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : SULAIMAN, Brian [GB/GB]; 20 Hardy Street, Morley, Leeds, West Yorkshire LS11 7AP (GB).

(74) Agent: BROWNE, Robin, Forsythe; Urquhart-Dykes & Lord, Tower House, Merrion Way, Leeds LS2 8PA (GB).

(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.

(54) Title: MIXING AND HOMOGENISING APPARATUS



(57) Abstract

Mixing and homogenising apparatus comprises a tubular passageway and a multiplicity of twisted laminar mixing elements arranged therein, the elements being selected from three or more distinct configurations.

MIXING AND HOMOGENISING APPARATUS

This invention relates to apparatus for colloidal fluid and liquid mixing and homogenising of fluid materials, particularly but not exclusively to apparatus for mixing high viscosity colloidal liquid mixtures.

When a colloidal system is unstable, the particles therein have a tendency to aggregate. Thermal motion causes the particles to collide frequently, especially when there is a high concentration of solids. The extent to which particles coalesce depends on the electrical forces between them. Thus the zeta-potential governs the stability of a colloidal system. If of a sufficient magnitude, the zeta-potential can prevent agglomeration of particles in a suspension. Agglomeration is a problem in many industries for example the ceramics industry, where materials are sought to be uniformly deposited from suspensions.

UK patent 1122493 discloses apparatus for mixing two liquids comprising a plurality of sheet like elements disposed within a hollow tube. The elements are twisted to create shear in a liquid passing through the tubes. Rotational motion imparted to the liquid causes turbulent mixing without need for any moving parts. Adjacent elements may have the same shape, an opposite twist or they may be arranged in groups of the two kinds of elements. The present invention is based on the observation that the configuration of the elements can have a considerable influence on the performance of such static mixing apparatus.

According to the present invention fluid mixing apparatus comprises a tubular passageway and a multiplicity of laminar mixing elements arranged therein, the elements being selected from three or more of distinct configurations.

The passageway is preferably cylindrical although polygonal or otherwise differently shaped arrangements may be employed.

The length of each element may be between one and two times the diameter of the passageway, preferably approximately 1.5 times the diameter. However the elements may be varied as described below.

Preferred apparatus in accordance with this invention incorporates an upstream group of first units, each first unit comprising a twisted laminar element extending radially of the passageway and being arranged to divide a flow of liquid entering the apparatus into a plurality of streams and each said element being twisted axially to impart rotational velocity to said streams.

The streams are preferably generally of equal size, two, three or four streams being preferred. The laminar elements are preferably twisted through an angle, preferably 90° between the ends thereof.

The number of elements and streams into which the fluid flow is divided may be selected according to the viscosity of the fluid. A fluid of about 90 to 200 poise may be divided into two streams, a fluid of about 40 to 90 poise into three streams and a fluid of less than 40 poise into four streams.

In preferred embodiments of the invention the leading first element extends from the upstream end of the tubular passageway by a short length, for example 2mm.

Preferred embodiments of the invention further incorporate at least two of second mixing units each unit comprising a pair of elements, each element having a different axial dimension. In preferred embodiments of the invention each element of the pair has a similar configuration and the leading element has an axial dimension 1.5 to 2 or more times that of the downstream element of the pair. Adjacent elements of each pair may have opposite handed twists. The spaces between elements may be arranged to afford regions of reduced shear to enhance mixing.

Preferred embodiments of the invention incorporate third turbulent mixing units each comprising elements disposed downstream of the second mixing unit. The third units may be arranged in pairs of alternating right handed and left handed twisting elements, arranged to produce counter rotating vortices in liquid flowing through them.

Preferred apparatus in accordance with this invention includes fourth shearing units located downstream of the

first to third units. The shearing units comprise twisted laminar elements having pointed leading or upstream edges and may include in addition rhomboid or rectangular laminar members. The shearing units are preferably arranged in oppositely twisted pairs.

Preferred apparatus in accordance with this invention incorporates one or more terminal units located downstream of the preceding units. The terminal units serve to minimise or prevent bubble formation as the fluid pressure is reduced at the exit from the apparatus. The terminal units may comprise twisted laminar members or may incorporate one or more annular elements, for example having a barrel shaped configuration.

Apparatus in accordance with this invention may be used for mixing and homogenising a wide variety of materials, ranging from liquid/liquid mixtures or emulsions with low density and viscosity to fluids containing a high proportion of solids, for example up to 80% solids and/or a high range of viscosities up to 200 poise. Apparatus in accordance with the invention facilitates homogenising and mixing of fluids containing different proportions of solids without need for modification of the apparatus.

The apparatus may also incorporate means for applying pressure to the fluid passing through the tubular housing. A flow rate of 35 to 850 cm^3s^{-1} has been found to be suitable for mixing solid suspensions, such as ceramic slips, inks and surface coatings. A pressure of 6000 psi may be employed.

The apparatus may include a heating or cooling jacket surrounding said passageway. This facilitates use of the apparatus for mixing of viscose or high melting materials. Blending of polymers is facilitated.

Apparatus in accordance with this invention finds application in manufacture of a variety of products. Multi-layer capacitors, electrode incs, semi-conducting and super-conducting materials, coatings, paints, enamels and other ceramics may be compounded. Liquid paints may be blended.

Mixing times are greatly reduced and a high degree of homogeneity is attained. Use of the apparatus allows a closed system to be employed, avoiding the need for clean room facilities and allowing recycling of materials. Pharmaceutical, foodstuffs or other sterile materials may be compounded. Labour costs in compounding of mixtures and emulsions are reduced.

The invention is further described by means of example, but not in any limitative sense with reference to the accompanying drawings of which:

Figure 1 shows three configurations of leading units;

Figure 2 shows three configurations of mixing units;

Figure 3 shows a turbulent mixing element;

Figure 4 shows three configurations of shearing units;

Figure 5 shows three configurations of terminal units; and

Figures 6 to 8 are segmented sectional views of apparatus in accordance with the invention.

Figure 1 shows three configurations of leading units for use with different viscosity fluids. Low viscosity fluids may be handled using the element shown in Figure 1a. Figure 1b is a cross-section of the leading portion of the element and Figure 1c is a cross-section of the trailing or downstream portion of the element shown in Figure 1a. The element contained within the tubular housing 1 is composed of laminar sheet material arranged to form to perpendicular sheets 2, 3 which extend to the wall of the tubular passageway 1. The sheets are twisted to be out of phase at the trailing end as shown in Figure 1c, so that the element has a spiral configuration. The unit extends a short distance, for example 2mm from the opening of the tube 1 and is arranged to divide a fluid flow into four generally equal streams. Rotational motion is imparted to the streams by the twisted configuration of the elements.

Figure 1d shows an alternative arrangement for use with liquid having a viscosity of approximately 40 to 90 poise. Figure 1e shows a cross-section at the upstream end and

Figure 1f shows a cross-section at the downstream end. Three radially extending laminar members 8, 9 extend to the wall of the tube 7. The element is twisted so that the member 10, 11 at the downstream end of the element are out of phase with respect to the elements 8 and 9 at the upstream end.

Figure 1g illustrates an arrangement for use with higher viscosity fluids, for example having a viscosity of 90 to 200 poise. The laminar member 13 sends to the walls of the tube and divides the fluid stream into two portions. The upstream end of the laminar member 13 is twisted around the length of the element so that the downstream end 14 is perpendicular.

Apparatus in accordance with this invention would normally comprise a single leading unit selected according to the viscosity and other properties of the fluid. The overall length of the element may be 20 to 32mm for a tube of diameter about 5mm to 10mmof the element extending from the entrance to the tube. The length of the elements may be varied as desired.

Figure 2 illustrates second mixing units in accordance with this invention. Figure 2a illustrates a unit comprising a pair of second elements for use with low viscosity fluids, Figure 2d illustrates a pair of elements for use with fluids of viscosity approximately 100 poise and Figure 2g illustrates a pair of elements for use with viscosity approximately 200 poise. The arrangement shown in Figures 2a, 2b and 2c comprises a pair of elements each of which has a Z-like cross-section, the elements being twisted axially so that the leading edge of the element 21 and trailing edge 25 are reversed when viewed from opposite ends as shown in Figures 2b and 2c. The second element 24 connected to the first element 21 by means of an axial linkage 22 has a similar configuration to the element 21 but has a shorter length, so that the leading element of the pair has an axial dimension of · 1.5 to 2 times that of the downstream element. Both elements extend to the walls of the tube 20.

Figure 2d illustrates an alternative embodiment

incorporating a unit comprising two elements 31, 30 connected by means of a linkage 29. The elements have similar configurations, but the leading element 31 has a longer axial dimension at least twice the length of the downstream element. The configuration of the units shown by the leading and trailing cross-sections 2e and 2f is in the form of a twisted laminar sheet, the leading ends of the sheet being pointed to extend upstream of the element, the pointed ends being turned over to form the S-shaped configuration shown in Figure 2e. The downstream ends of each element are generally flat.

Figure 2g illustrates an element for use with a higher viscosity fluid, for example 90 to 200 poise. Each of the elements of the pair is in the form of a flat twisted sheet, the leading and trailing ends of each element being perpendicular. The second element of each pair 37 is smaller than the leading element 38 as previously described.

A plurality of units each comprising a pair of second elements would normally be employed the number being dependent on the properties of the fluid. The length of each element may be 20 to 40mm in a tube of internal diameter of 5 to 10mm preferably 9mm. Successive pairs of units may have the same or opposite twists. Alternatively each element of a pair may have opposite twists, one being clockwise, the other being anti- clockwise. The spacing between consecutive elements may be 0.5mm to provide regions of zero or reduced shear.

Figure 3 shows a turbulent mixing unit in accordance with this invention. The unit comprises longitudinally divided elliptical laminar elements, the divided portions 41, 42 being connected centrally to each other and are connected at the apices to adjacent further half elliptical portions. The half portions are arranged out of phase so that a fluid flow along the tube 40 becomes turbulent as shown in the Figure. Each element may comprise any convenient number of divided elliptical plates, consecutive elements being connected by an axial connection 45. The elliptical elements

41, 42 extend to the walls of the tube 40, reducing loss of fluid velocity along the inside walls of the tube 40. The counter rotating vortices generated by the element provide efficient mixing of the colloidal liquid or fluid. The preferred length of each element may be 8 to 25mm, the width being 2.4 to 7.5mm. Alternative dimensions may be selected as convenient dependent on the characteristics and nature of the ingredients. The turbulent mixing units illustrated in Figure 3 are located downstream of the mixing units illustrated in Figure 2.

Figure 4 illustrates shearing or homogenising mixing units in accordance with the invention. Figure 4a shows an arrangement for use with low viscosity fluids. Each unit comprises a pair of twisted laminar elements 62 each proceeded by a rhomboid laminar element 61. The elements 62 are pointed in the upstream and down stream directions for example at 63, the pointed ends being curved so the cross-section as shown in Figure 4c is S-shaped. The rhomboid elements 61 are folded axially as shown in the cross-section Figure 4b. The lengths of the twisted members 62 of each element may be between 20 to 50 mm with the spacers 64 having a length of 0 to 4 mm dependent on the properties and solid content of the fluid. The elements may also be twisted in the same direction or in opposite directions.

Figure 4d illustrates a unit for use with viscosities of about 40 to 90 poise. Each unit comprises a pair of twisted laminar members, upstream and downstream ends of which are pointed and curved to form oppositely handed S- shaped cross-sections as shown in Figures 4e and 4f.

Figure 4g shows an arrangement for use with higher viscosity liquids, for example 90 to 200 poise. The element comprises a twisted laminar member having pointed ends, 73 and folded rhomboid members 72 disposed upstream and downstream of the elements 73.

The number of shearing elements employed in apparatus in accordance with this invention may be varied in accordance

with the properties of the fluid. The lengths of the unit may vary from 20 to 50 mm according to the diameter of the tube which may be convenient 5 to 10 mm. The rhomboidal units may be folded or twisted through 30 to 60° with respect to the adjacent surface of the laminar member. The length of the spacers for example 64, 68 may be 2 to 5mm.

Figure 5 illustrates arrangements for the terminal end of apparatus in accordance with this invention. Figures 5a, 5d and 5g show units for use with low, medium and high viscosity fluids or colloidal suspensions. In order to prevent bubble formation in the liquid as the pressure reduces upon exit from the mixing and homogenising apparatus, low viscosity apparatus may incorporate hollow barrel shaped units 51 with twisted laminar members 52, 53 extending between them. Figures 5b and 5c show cross- sections of the upstream and downstream ends 52, 53 respectively of the twisted laminar member. Figure 5d shows an alternative arrangement wherein the terminal element incorporates a single barrel shaped member 57 with two adjacent twisted plate-like members 55. Figure 5g illustrates a high viscosity arrangement wherein the barrel shaped elements are omitted, a single twisted plate-like member being employed. It is preferred that the terminal elements do not extend beyond the outlet of the tube 50, 54 and 58.

Apparatus in accordance with this invention my include various arrangements of elements within a single tube. Use of at least one of each of the five configurations is preferred although one or more may be omitted as necessary. It has been found that a tubular unit having a length of 40 to 110cm is adequate for most purposes, longer lengths being preferred for fluids containing a high solid content or otherwise requiring a higher degree of mixing. The length can be changed in accordance with any changes in diameter.

The number and configuration of the units may be selected in accordance with the properties of the fluid and any suspended solids.

Figure 6 is a partially cut away segmented view of

apparatus in accordance with this invention for use in mixing higher viscosity or higher solid content fluids such as ceramic slips. The apparatus may comprise one leading unit 70, four mixing units comprising leading element 72 and trailing element 73, four pairs 74 of turbulent units each comprising a pair of elements 75, 76, four shearing units 77 and four terminal units 78. Although the number and arrangement of the units may be varied in accordance with the properties of the fluid, the above configuration has been found to be appropriate for ceramic slips with a viscosity of 170 poise.

Figure 7 illustrates an arrangement for use with medium viscosity fluids having a viscosity of 40 to 90 poise. Such fluids include solvents, paints, semi- conductor titanium dioxide suspensions and surface coatings. A single leading unit 80 may be employed together with three mixing units each comprising a pair of elements 81, 82. Three turbulent units 83 may each comprise a pair of elements. Six shearing units 84 and three terminal units 85 complete the apparatus.

Figure 8 illustrates a further embodiment for use with low viscosity carbon black slips, oil/water emulsions, paints and inks. A single leading unit 90 may be employed together with 10 mixing units each comprising a pair of elements 91, 92. Ten turbulent units 93 and ten shearing and homogenising units 94 may proceed ten of the terminal units 95.

In a typical application of this apparatus to formulation of fire resistant paint emulsions these may have a solids content of 35% w/w. Two mixing apparatus as shown in Figure 8 are used in parallel and are provided with water filled cooling jackets. A flow rate of 35 l min^{-1} through each passageway provides a total flow of 70 l min^{-1}. The temperature within the apparatus may rise to 60°C due to internal friction. A pressure of 1500 psi may be necessary to produce the aforementioned flow rate.

Figure 9 illustrates an alternative turbulent mixing unit. This unit comprises an axial member 100 with laterally extending fins 101 extending to the walls of the

passageway (not shown) and shorter fins 102 which do not extend to the walls. Adjacent fins 101 102 extend from the axial member 100 in different directions, being inclined for example at an angle of 90°. The construction of the unit shown in Figure 9 may be appreciated from Figure 10 which illustrates a flat, untwisted formation from which the unit shown in Figure 9 is obtained by twisting about the axial member. In use the fins 101 102 may be inclined forwardly or backwardly with respect to the direction of fluid flow as convenient.

Figure 11 illustrates an unfolded member from which the unit shown in Figure 6 at 74, Figure 7 at 83 or Figure 8 at 93 may be formed. During manufacture of the unit the blank 103 is folded perpendicularly at the narrow portions 104 in an alternate manner to give an alternating arrangement. Two such folded members may be interlocked at the rebates 105 and spot welded to form the units shown in the preceding Figures.

Figure 12 shows the blank unfolded formations from which preferred units in accordance with this invention may be manufactured.

Figure 12a illustrates a turbulent mixing unit having a rectangular aperture 106 presenting a perpendicular surface 107 to the fluid flow. This increases the shear on the liquid enhancing turbulent mixing. In addition forward facing projections 108 further increase the turbulent effect. In use the elements shown in Figure 12 are twisted as shown in the preceding Figures so that each unit, for example 109 is twisted about the narrow portion 110 relative to the adjacent unit. In preferred embodiments, the unit 109 is perpendicular to the adjacent unit. The elements 110 112 of the unit are also twisted as may be seen in the preceding Figures. Figures 12b to 12g illustrate alternative embodiments of the invention. These are arranged to provide different degrees of severity of shear to the liquid to be mixed. The members of each unit may be identical as shown in Figures 12b, 12d, 12f or 12g or may be arranged in pairs as shown in Figures 12a or 12e.

CLAIMS

1. Fluid mixing apparatus comprising a tubular passageway and a multiplicity of laminar mixing elements arranged therein, the elements being selected from three or more distinct configurations.

2. Apparatus as claimed in claim 1, wherein the elements are arranged in groups, each element within a group having an identical configuration to other elements of the group.

3. Apparatus as claimed in claim 1, wherein an element within said group is a mirror image of another element within the group.

4. Apparatus as claimed in any preceding claim, wherein the passageway is cylindrical and said elements are symmetrical about the axis of the passageway.

5. Apparatus as claimed in any preceding claim wherein the elements are immobilised within the passageway.

6. Apparatus as claimed in any preceding claim, incorporating an upstream group of first units, each first unit comprising a twisted laminar element extending radially of the passageway and being arranged to divide a flow of liquid entering the apparatus into a plurality of streams, each said element being twisted axially to impart rotational velocity to said streams.

7. Apparatus as claimed in claim 6 wherein the streams are of equal size.

8. Apparatus as claimed in claim 6 or 7 wherein the laminar elements are twisted through an angle of 90° to 120° between the ends thereof.

9. Apparatus as claimed in any of claims 6 to 8 wherein the leading first element extends from the upstream end of the tubular passageway.

10. Apparatus as claimed in any preceding claim including a plurality of second mixing units each second mixing unit comprising a pair of elements, each said element having a different axial dimension.

11. Apparatus as claimed in claim 10 wherein each element of the pair has a similar configuration and the leading element has an axial dimension 1.5 to 2 or more times the axial dimension of the downstream element of said pair.

12. Apparatus as claimed in claim 10 or 11 wherein adjacent elements of each pair have opposite handed twists.

13. Apparatus as claimed in any of claims 10 to 12, incorporating third turbulent mixing units, each said third unit comprising elements disposed downstream of said second mixing units, said third units being arranged in alternating pairs.

14. Apparatus as claimed in any of claims 10 to 13 incorporating fourth shearing units located downstream of said third units, the shearing units comprising twisted laminar elements having pointed leading or upstream edges.

15. Apparatus as claimed in claim 14 wherein said fourth units are arranged in oppositely twisted pairs.

16. Apparatus as claimed in claims 14 or 15 wherein the shearing units include rhomboid laminar elements.

17. Apparatus as claimed in any of claims 10 to 16 incorporating one or more terminal units located downstream of preceding units.

18. Apparatus as claimed in claim 17 wherein said terminal units include generally cylindrical members.

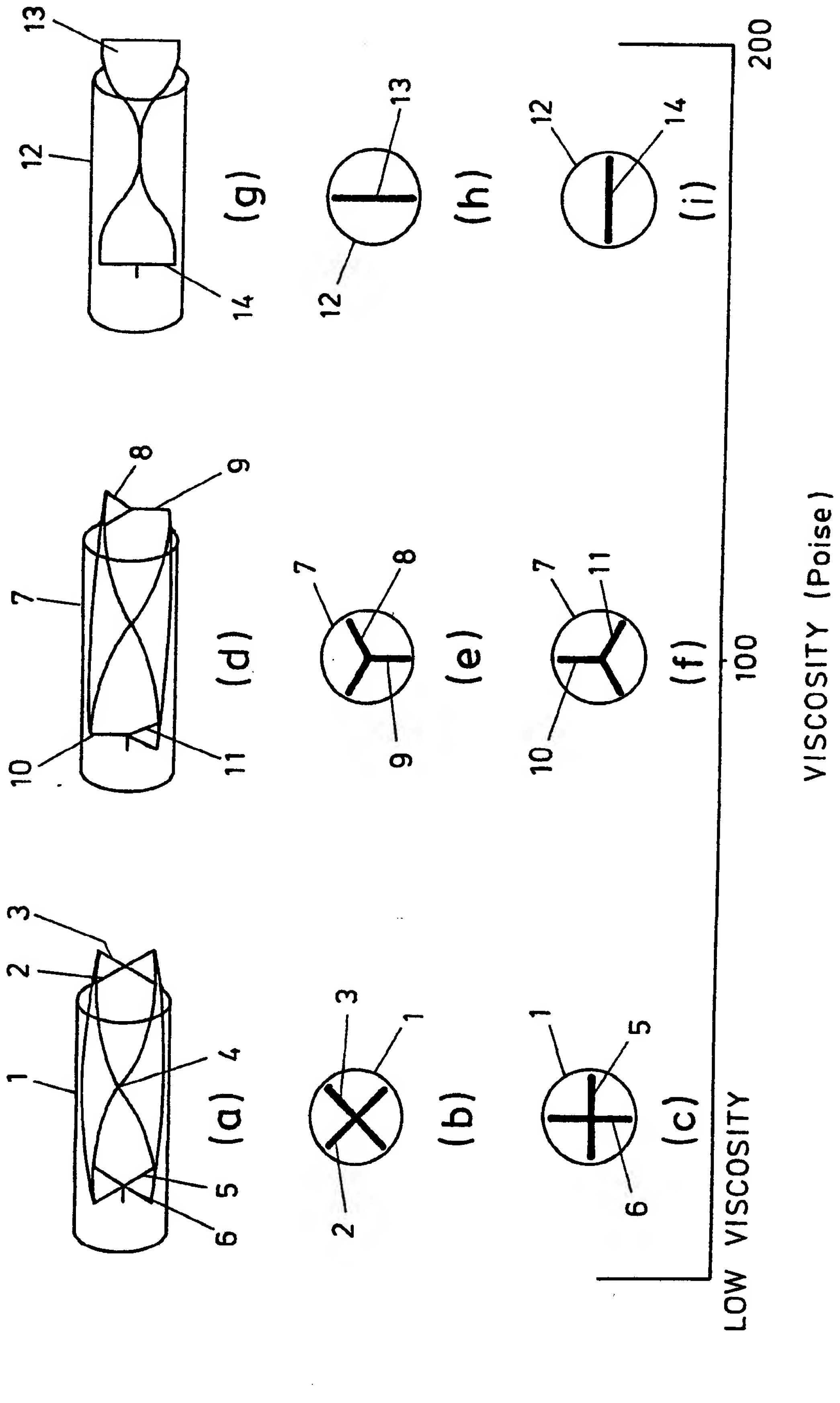

(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
1
2
3
4
5
6
7
8
9
10
11
12
13
14
LOW VISCOSITY
100
200
VISCOSITY (Poise)

FIG. 1

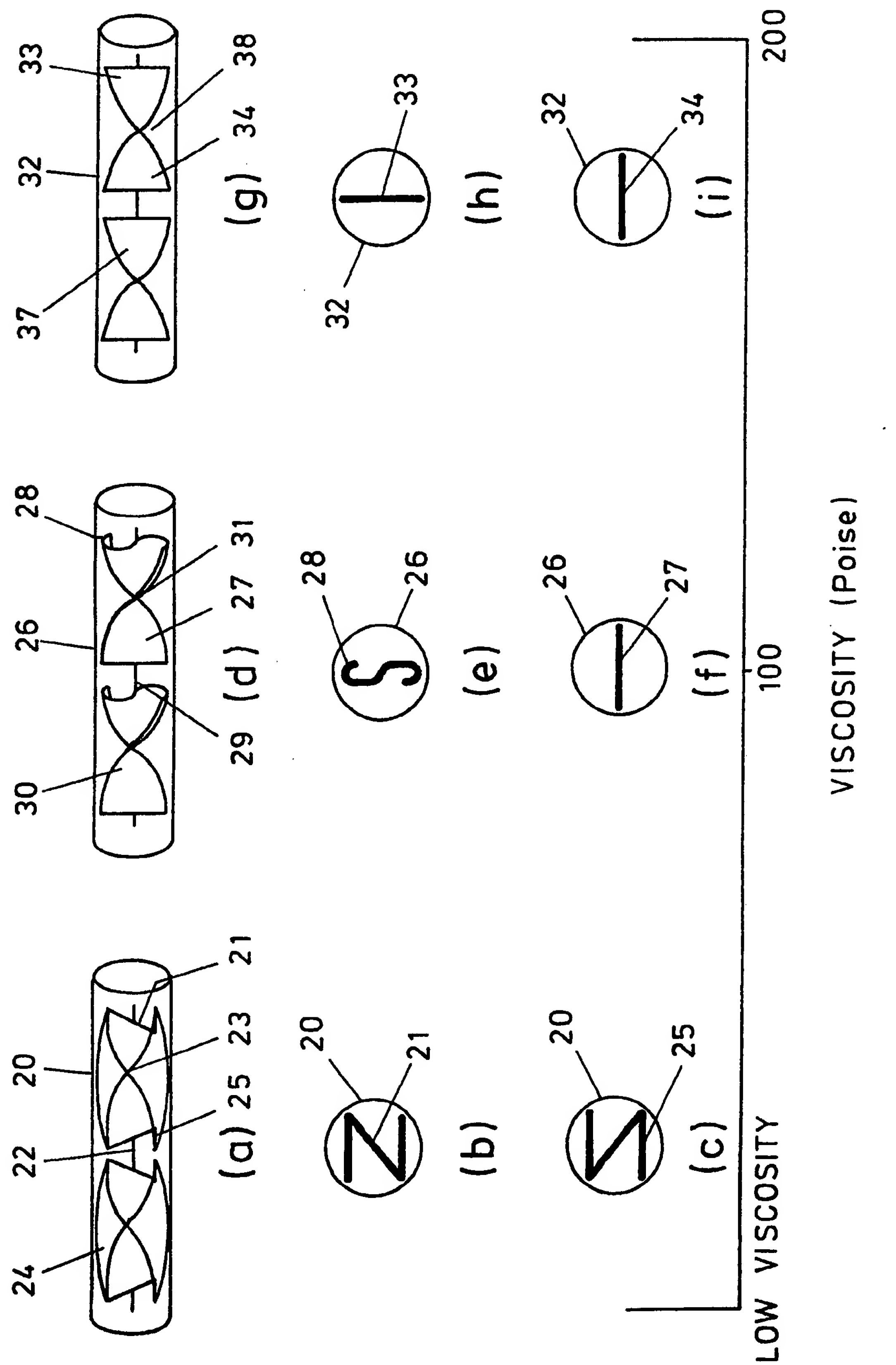


FIG. 2

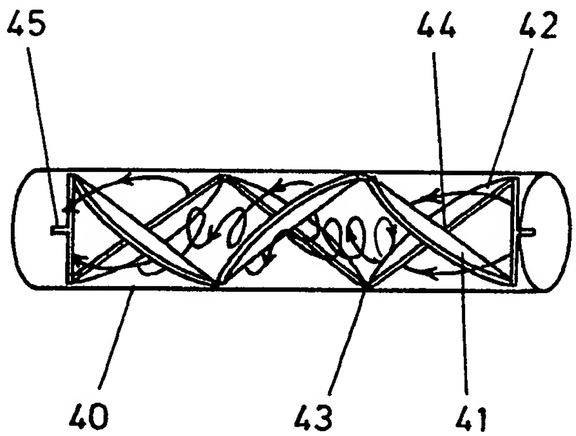


FIG. 3

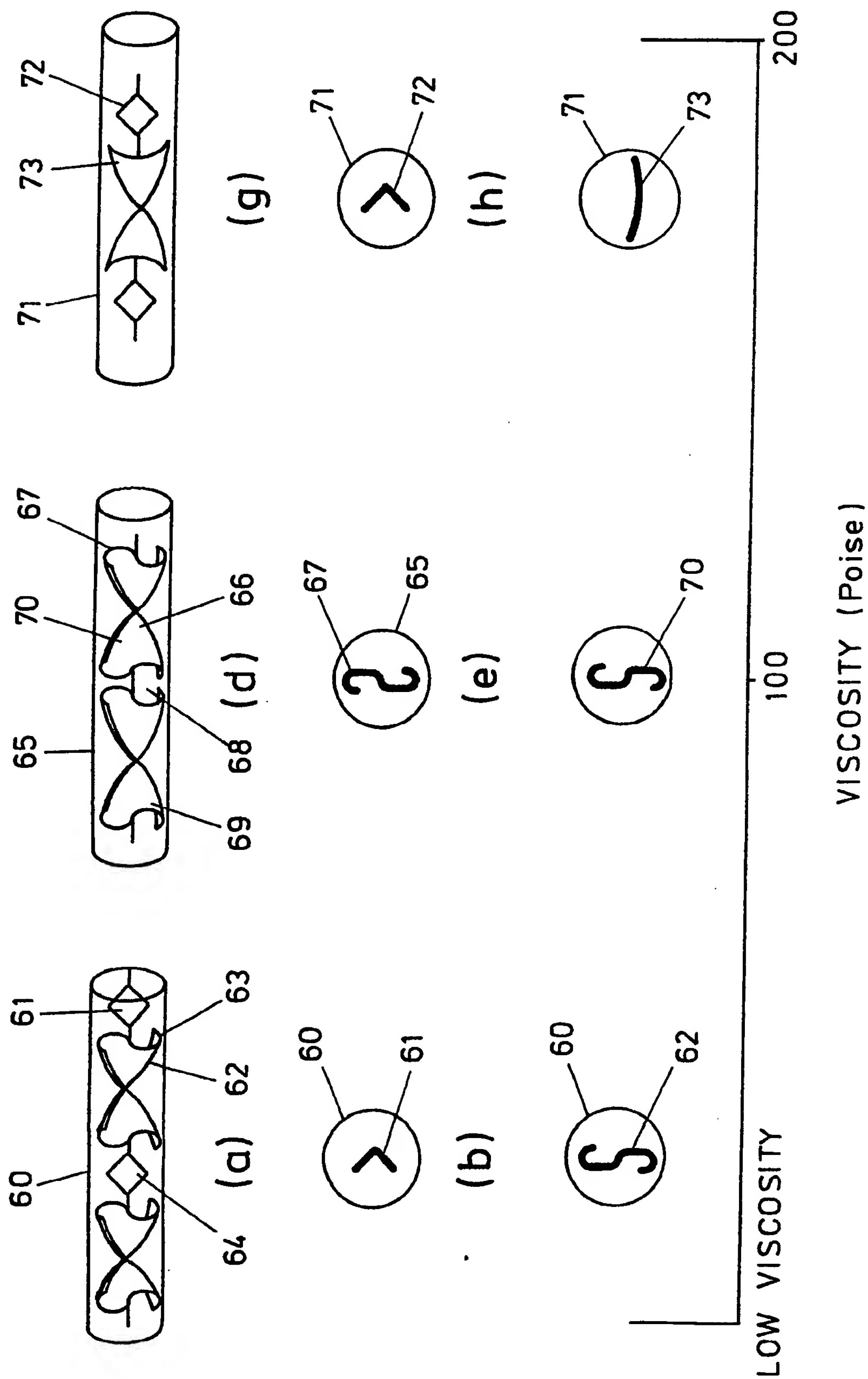

60
61
62
63
64
(a)
(b)
65
66
67
68
69
70
(d)
(e)
71
72
73
(g)
(h)
LOW VISCOSITY
100
200
VISCOSITY (Poise)

FIG. 4

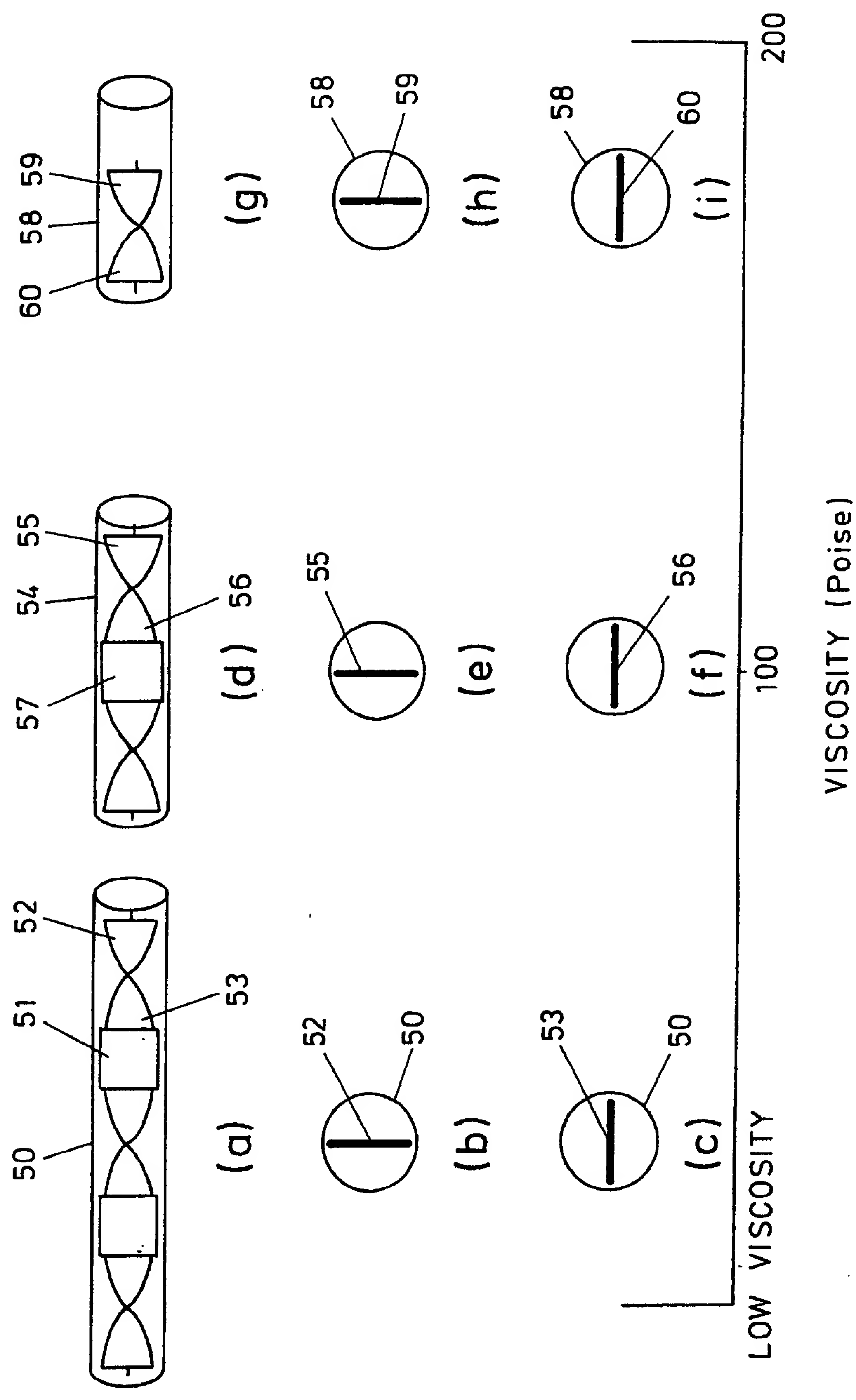

50
51
52
53
(a)
(b)
(c)
52
50
53
50
54
55
56
57
(d)
(e)
(f)
55
56
58
59
60
(g)
(h)
(i)
58
59
58
60
LOW VISCOSITY
100
200
VISCOSITY (Poise)

FIG. 5

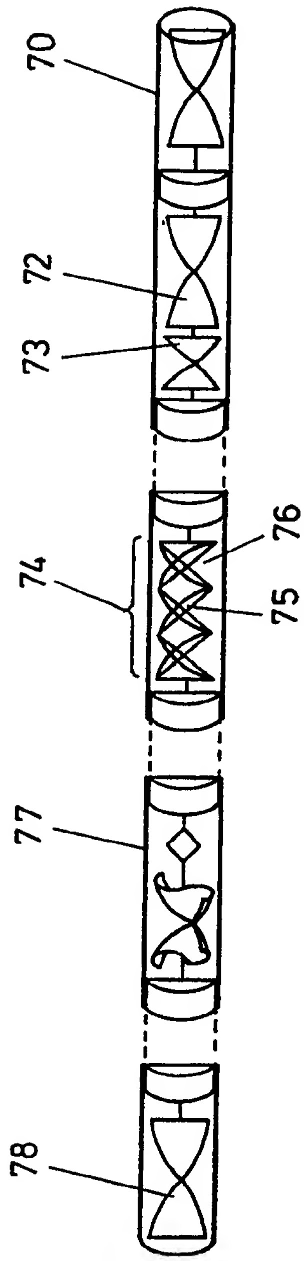


FIG. 6

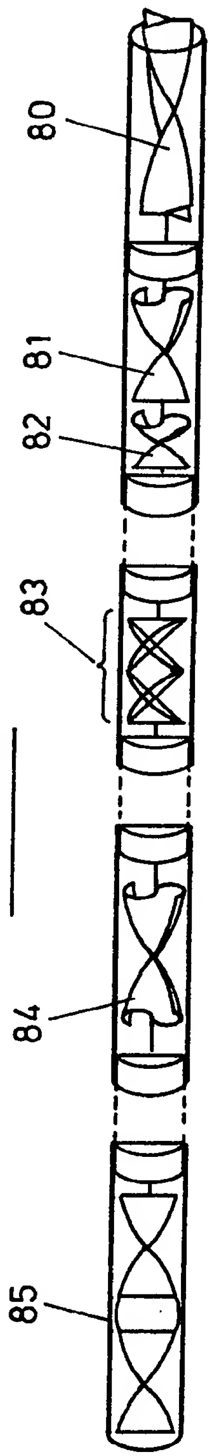


FIG. 7

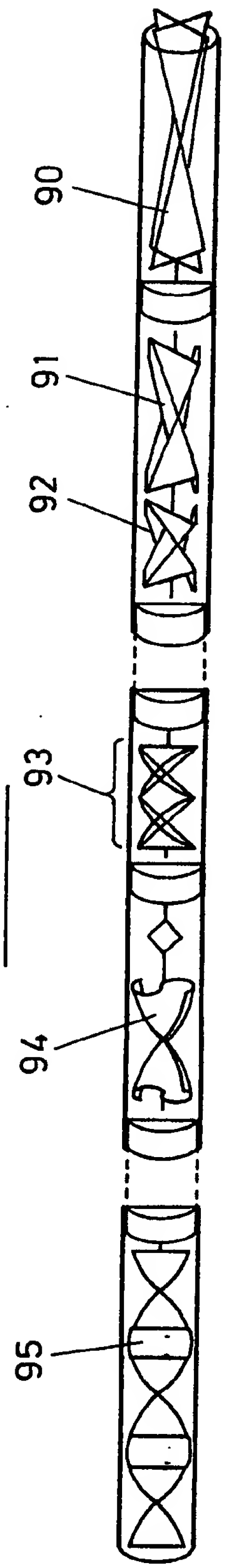


FIG. 8

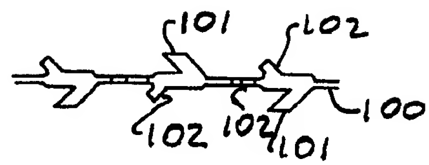


FIG. 9

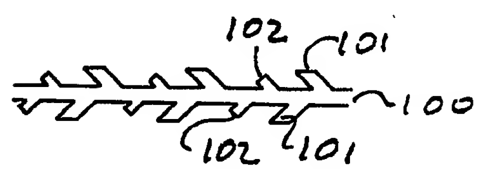


FIG. 10

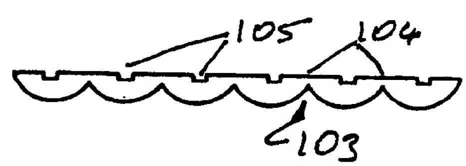


FIG. 11

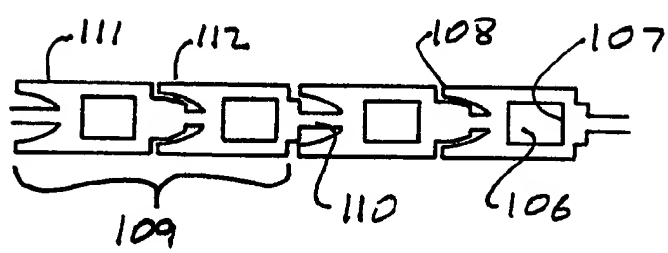


FIG. 12a

FIG. 12b

FIG. 12c

FIG. 12d

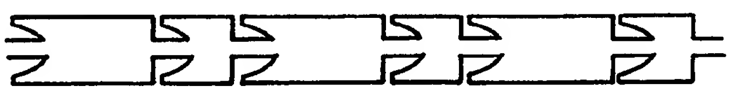


FIG. 12e

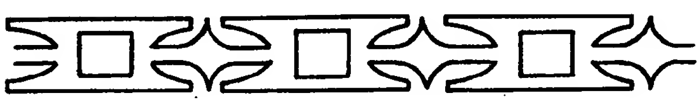


FIG. 12f

FIG. 12g

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 92/00311

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B01F5/06

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	B01F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
A	GB,A,1 486 495 (ANGLIAN WATER) 21 September 1977 see figures	1-18
A	US,A,4 826 089 (PSALTOPOULOS) 2 May 1989 see figures	1
A	US,A,3 969 037 (STEINER) 13 July 1976	
A	FR,A,2 634 625 (QUELEN) 2 February 1990	
A	GB,A,2 086 249 (MITSUI TOATSU) 12 May 1982	
A	US,A,4 936 689 (FEDERIGHI) 26 June 1990	
A	US,A,3 861 652 (CLARK) 21 January 1975	
A	DE,A,2 262 016 (MONO PUMPS) 20 June 1974	

° Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
19 MAY 1992	12. 06. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	PEETERS S.

1

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9200311
SA 56846

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 19/05/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
GB-A-1486495	21-09-77	None		
US-A-4826089	02-05-89	US-A-	4878624	07-11-89
US-A-3969037	13-07-76	US-A-	3947939	06-04-76
		CA-A-	1024857	24-01-78
FR-A-2634625	02-02-90	None		
GB-A-2086249	12-05-82	JP-C-	1282065	27-09-85
		JP-A-	57068125	26-04-82
		JP-B-	60002899	24-01-85
US-A-4936689	26-06-90	None		
US-A-3861652	21-01-75	CA-A-	991632	22-06-76
		GB-A-	1394519	14-05-75
		NL-A-	7315604	17-05-74
DE-A-2262016	20-06-74	None		

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82